Docket No.: 21806-059-US
(PATENT)

#21

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:
Thomas G. Ference, et al.

Conf. No. 7631

Response
J. McMillan
8/22/02

Application No.: 09/261,328

Group Art Unit: 2814

Filed: March 3, 1999

Examiner: D. Graybill

For: ULTRA-FINE CONTACT ALIGNMENT

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RESPONSE AFTER FINAL REJECTION UNDER 37 CFR 1.116

August 21, 2002

BOX AF
Commissioner for Patents
Washington, DC 20231

Dear Sir:

In response to the Office Action dated May 21, 2002 (Paper No. 19), finally rejecting claims 1-6, 10-18, 20, 25, 55, 56, 58, and 59, the following remarks are submitted in connection with the above-identified application:

REMARKS

Bearing in mind the comments in the final Official Action and the arguments presented herein below, the application is believed to be in condition for allowance. An early indication of the same would be appreciated.

Claims 1-6, 10-18, 20, 25, 55, 56, 58, and 59 are now pending in this application. Claims 1 and 55 are independent. Claims 60-61 were recently indicated by the Examiner as having been withdrawn from consideration as being drawn to a non-elected species; claims 7-9, 19, and 21-24 were previously withdrawn as being directed to non-elected species; and claims 26-53 were previously withdrawn as being directed to a non-elected invention. Applicants reserve the right to request rejoinder of these claims along with previously withdrawn species claims when a generic linking claim is allowed or, in the alternative, to present the withdrawn claims in a timely filed continuing application.

Application No.: 09/261,328 Docket No.: 21806-059-US

Objection to the Amendment filed March 11, 2002

Withdrawal of the objection to the amendment under 35 U.S.C. §132 is requested. The Examiner incorrectly asserts that the amendment filed March 11, 2002 introduces new matter into the disclosure. In particular, the Examiner asserts that the added material which is not supported by the original disclosure is the limitation of "C4", i.e., "controlled collapse chip connection", in claim 1, lines 5, 7, 9, 10, and 12; and in claim 55, lines 5, 7, 9, 10, and 12. Applicants respectfully traverse this assertion of "new matter".

Applicants invite the Examiner's attention to the "Background of the Invention" section of the disclosure at page 2, line 1 through page 3, line 1, where the conventionally achievable "controlled collapse chip connection", i.e., "C4" capabilities are discussed as background for the C4 interconnection improvement in Applicants' claimed structure.

Further the Examiner is invited to consider the disclosure provided at least in the "Detailed Description of the Invention" section on page 7, line 18 through page 8, line 24; page 18, lines 15-19 and Figs. 3, 4; and discussion of a new method of making C4 interconnects found on page 23, lines 12-16.

Clearly, the Specification is replete with disclosure of C4 contacts and interconnection structures, and even more clearly, C4 interconnection structures and methods were contemplated and disclosed in the original Specification in a manner which would enable a person having skill in the art to adequately comprehend the invention.

In consideration of the above, and in view of the original disclosure of C4 interconnection structures and methods, withdrawal of the objection to the previously submitted amendment is requested.

Enablement Rejection under 35 U.S.C. §112, first paragraph

Withdrawal of the rejection of claims 1-6, 10-18, 20, 25, 55, 56, 58, and 59 under 35 U.S.C. §112, first paragraph, as not being enabled by the Specification, is requested. The Examiner erroneously asserts that the limitations in claims 1 and 55 concerning "C4 contacts" are not described in the Specification.

As discussed above, the Examiner's attention is invited to the Specification at page 2, line 1 through page 3, line 1; page 7, line 18 through page 8, line 24; page 18, lines 15-19 and Figs. 3, 4; and discussion of a new method of making C4 interconnects found on page 23, lines 12-16. "C4" contacts are submitted as being disclosed and made a part of the original disclosure in such a way as to reasonably convey to a person with skill in the art that the inventors had possession of the claimed invention.

With respect to the rejection of claim 4, 10-15, 20, and 59, the undersigned does not understand the Examiner's further clarification of the rejection of claims 4, 10-15, 20 and 59. The Examiner asserts that there is no original description of the limitation "wherein the contacts are aligned by a solder material which is in contact with the contacts when the contacts comprise second contact bumps." Applicants traverse the Examiner's assertion quoted above. Quite simply, there is no such limitation recited in the pending claims.

What is recited in independent claim 1, from which claims 4, 10-15, and 20 all depend, is "...a plurality of C4 contacts between the first substrate and the second substrate; and a plurality of first solder bumps connected between the first substrate and the second substrate which substantially align the plurality of C4 contacts...wherein the plurality of C4 contacts are further aligned between the first and second substrates by a surface tension provided by a solder material which is in contact with each of the plurality of C4 contacts."

In conjunction with the discussion above relating to disclosure of "C4" contacts, support for the claimed limitation of claim 1 may be found at page 3, line 19 through page 4, line 1; page 9, lines 1-8, and lines 20-22; and page 10, lines 6-14, and lines 21-22. Further, Figs. 1a-1c, for example, also illustrate the alignment of both the plurality of first solder bumps (i.e., 114, 116), and the plurality of C4 contacts (i.e., 110 and 112).

Further, originally presented claim 4 recites that "the contacts comprise second solder bumps". Support for this aspect of the claimed invention may be found in the Specification at least at page 12, lines 14-17; at page 16, lines 14-16; and at page 22, lines 17-18. Applicant further points out that the claims as filed in the original Specification are part of the disclosure.

Therefore, if necessary, the Specification may be amended to include the claimed subject matter.[1] However, such amendment to the Specification is not believed to be necessary and has not been undertaken, as the subject matter of claim 4 is submitted as already being present in, and enabled by the Specification.

Still further, originally presented claims 10-15 recite contacts having particular dimensional characteristics. Support for these various aspects of the claimed invention may be found in the Specification at least at page 11, line 11 through page 12, line 9, and Table 1. Applicant further points out that the claims as filed in the original Specification are part of the disclosure. Therefore, if necessary, the Specification may be amended to include the claimed subject matter.[2] However, such amendment to the Specification is not believed to be necessary and has not been undertaken, as the subject matter of claims 10-15 is submitted as already being present in, and enabled by the Specification.

Originally presented claim 20 recites that "the contacts comprise solder." Support for this aspect of the claimed invention may be found in the Specification at least at page 12, lines 14-19. Applicant further points out that the claims as filed in the original Specification are part of the disclosure. Therefore, if necessary, the Specification may be amended to include the claimed subject matter.[3] However, such amendment to the Specification is not believed to be necessary and has not been undertaken, as the subject matter of claim 20 is submitted as already being present in, and enabled by the Specification.

Claim 59, although not originally presented with the filing of this application, has support in the original disclosure. Claim 55, from which claim 59 depends, recites "a plurality of C4 contacts between the first substrate and the second substrate; and a plurality of first solder bumps connected between the first substrate and the second substrate which substantially align the plurality of C4 contacts...wherein the plurality of first solder bumps are free of electrical connection with any of the plurality of C4 contacts." The discussion of the enablement of "C4" contacts, discussed above, is likewise relevant with respect to claims 55 and 59, and the

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[1] *See* MPEP §2163.06(III).
[2] *See Id.*
[3] *See Id.*

recitation relating to the first solder bumps being free of electrical connection with any of the C4 contacts may be clearly seen in Fig. 2, for example.

Claim 59, depending from independent claim 55, recites that "the plurality of contacts comprise a plurality of second solder bumps each having a volume smaller than a volume of each of the plurality of first solder bumps." Support for this aspect of the claimed invention may be found in the Specification at least at page 12, line 21 through page 13, line 1. In this disclosure, Applicants note the somewhat obvious conclusion to be drawn from this passage relating to diameters of the bumps is that the volume of a solder bump is clearly related to the diameter of the bump, or as more correctly known, directly proportional to the square of the diameter, when the bump approximates a spherical bump. Applicant further points out that the claims as filed in the original Specification are part of the disclosure. Therefore, if necessary, the Specification may be amended to include the claimed subject matter.[4] However, such amendment to the Specification is not believed to be necessary and has not been undertaken, as the subject matter of originally presented claim 32, which recites, "the second solder bumps are provided with a smaller size than the first solder bumps", is submitted as already being present in, and enabled by the Specification, and is analogous to the recitation of pending claim 59.

Originally presented claim 16 recites that "the contacts comprise a material having a higher melting point than the first solder bumps". Support for this aspect of the claimed invention may be found in the Specification at least at page 10, lines 21 through page 11, line 1; and at page 13, line 23 through page 14, line 9. Applicants further point out that the claims as filed in the original Specification are part of the disclosure. Therefore, if necessary, the Specification may be amended to include the claimed subject matter.[5] However, such amendment to the Specification is not believed to be necessary and has not been undertaken, as the subject matter of claim 16 is submitted as already being present in, and enabled by the Specification.

Although not originally presented in the initial filing of this application, dependent claim 58 finds support in the original disclosure. Claim 58, depending from independendent claim 55,

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[4] *See Id.*.
[5] *See Id.*.

further recites, "a ledge on the first substrate, wherein all the plurality of contacts are arranged on the ledge such that a lower surface of each of the plurality of contacts is coplanar with the ledge, and none of the plurality of first solder bumps are coplanar with the ledge, and wherein an upper surface of each of the plurality of first solder bumps are essentially aligned with an upper surface of each of the plurality of contacts on a surface of the second substrate opposing the first substrate."

Support for this aspect of the claimed invention may be found, for example, at least at page 17, line 1 through page 18, line 19, and in original Figs. 3-6.

Accordingly, Applicants respectfully request withdrawal of the enablement rejection of claims 1-6, 10-18, 20, 25, 55, 56, 58, and 59 under 35 U.S.C. §112, first paragraph.

Traversal of the Examiner's Requirement for Additional Drawings

Applicants respectfully traverse the Examiners requirement for additional drawings to "facilitate understanding of the invention encompassed by the non-described subject matter of claims 1-6, 10-18, 20, 25, 55, 56, 58, and 59, as set forth above in the 35 U.S.C. §112, first paragraph rejection supra."

Applicants submit that the limitation objected to by the Examiner as "new matter", i.e., "C4 contacts", is illustrated, although not to scale, at least in Figs. 1(a)-1(c), Fig. 2, Fig. 3, Fig. 4, and Figs. 8(a)-8(c). The Examiner's further attention is invited to Fig. 4 and the associated discussion in the Specification at least at page 18, lines 15-19, wherein C4 connections are clearly implicated. Applicants also point out the permissible lexigraphic interchangeability, in this context and in the claims and specification, between the disclosed "C4 connection", and the claimed "C4 contact".

Applicants submit that the claimed invention is adequatedly depicted by the originally presented Drawing Figures 1-9, and the subsequently filed Formal Drawings, and that additional new drawings are not necessary to facilitate an understanding of the claimed invention.

Withdrawal of the requirement for additional drawings is requested.

Indefiniteness Rejection under 35 U.S.C. §112, second paragraph

Withdrawal of the rejection of claims 1-6, 10-18, 20, 25, 55, 56, 58, and 59 under 35 U.S.C. §112, second paragraph, as being indefinite is requested.

The Examiner's contention that "it is unclear how the term 'C4' further structurally limits the scope of the term 'contacts' and the scope of the term 'C4 contacts' cannot otherwise be determined" is somewhat puzzling, given the Examiner's indication during the past interview with the undersigned that he was familiar with C4 technology, and given the Examiner's quotation of a sourced technical definition of the term "C4" in the final Official Action, in connection with the anticipation rejection of the pending claims over Nishiguchi, discussed below.

Controlled collapse chip connections (C4), *per se*, are acknowledged as being known to persons having skill in the art. In fact, C4 interconnect technology, also sometimes called flip-chip or face-down bonding, has been successfully used in the semiconductor industry for over 30 years for interconnecting high I/O (input/output) count and area array solder bumps on the silicon chips to base ceramic chip carriers, for example. The claimed invention improves upon the known, conventional C4 approaches, and allows even higher levels of integration and interconnection density, using the novel and non-obvious approach recited in the pending claims.

Responsive to the Examiner's query as to how recitation of "C4" structurally limits the scope of the term "contacts", and by way of background, the present application, in a preferred embodiment, is concerned with providing a structure and method for joining two substrates in a semiconductor structure for "controlled collapse chip connection" (C4) interconnection of devices having self-aligning capabilities to ensure proper alignment of the two structures joined.

The self-aligning aspects of Applicants' claimed invention are brought about by using relatively "large" solder bumps to roughly, or initially align a plurality of C4 contacts between two substrates. Then, surface tension in wetted solder which is in contact with each of a plurality of C4 contacts is relied upon to finely align the tightly spaced C4 interconnects to a level, typically, within 10% of the solder bump diameter. The level of fine alignment of C4 interconnect achieved by Applicants' novel approach is submitted as not being achievable with

conventional alignment techniques, such as are disclosed in the applied art, discussed *infra*, which rely upon physical force or external movement of the contacts to achieve alignment.

Consequently, within the arena of known C4 technology, Applicants' claimed invention achieves an order of magnitude or more improvement in the number of C4 interconnects which are now possible to be joined. For example, as discussed in the Specification, the conventional limit for C4 interconnection technology, which has a C4 connection diameter of about 50mm, on a pitch of about 100mm, is, at most, about 10,000 C4 interconnects. This results in a chip having an area of about $1cm^2$. The structure and method of the present Application allows a much greater interconnect density, compared with current C4 technology, e.g., 100,000 interconnects per square centimeter, an order of magnitude or more increase, between the structures being joined.

For such an improved contact density, the contacts would have approximately, for example, a 15μm diameter, on a pitch of approximately 30μm. To achieve about 50% alignment of the C4 contacts, a 7.5μm alignment tolerance would be necessary from the initial alignment of the rough align solder bumps, i.e., the "larger" bumps. The large solder bumps have approximately a 10% alignment capability, allowing use of a solder bump having approximately a 75μm diameter, on a 150μm pitch. These limits on the large solder bumps are readily achievable with conventional component placement machines. The fine alignment achieved by the recited invention does not rely upon the machine placement accuracy, as long as the large solder bumps are placed within the above limits, for example. Surface tension acting on the C4 contacts is used to achieve the fine C4 interconnect alignment.

To summarize, the term "C4" is known to persons with skill in the art, and connotes a particular type of interconnection structure, which relies upon the surface tension in the liquid solder to control the height of a collapsed solder joint.

Applicants respectfully traverse the Examiner's contention that the limitation of claim 58 of "wherein all of the plurality of contacts are arranged on the ledge such that a lower surface of each of the plurality of contacts is coplanar with the ledge, and none of the plurality of first solder bumps are coplanar with the ledge" is somehow inconsistent with the limitation in independent claim 55, from which claim 59 depends, of "wherein an upper surface of each of the plurality of first solder

bumps are essentially aligned with an upper surface of each of the plurality of contacts on a surface of the second substrate opposing the first substrate."

Claim 55, as understood by the undersigned, does not contain the above-indicated recitation at all. It appears that the Examiner intended to refer solely to the recitations contained within dependent claim 58, which does include the claim language quoted by the Examiner, but which is attributed to claim 55.

Applicants submit that these two recitations contained within dependent claim 58 are complementary, and are, in no way, contradictory.

For example, and with reference to Figs. 3 and 4 of the Drawings, the following table is offered to ease the Examiner's understanding of the claim recitations of dependent claim 58:

Claim Recitation	**Comments**
The semiconductor structure of claim 55, further comprising a ledge on the first substrate,	See specification at page 17, lines 9-11, and "second level" 19.
wherein all of the plurality of contacts are arranged on the ledge such that a lower surface of each of the plurality of contacts is coplanar with the ledge, and none of the plurality of first solder bumps are coplanar with the ledge, and	See multiple contacts 7 on second level 19 ("ledge"), which all have a lower surface which is "on" or coplanar with the second level 19. None of solder bumps 5 ("first solder bumps") are coplanar with second level 19.
wherein an upper surface of each of the plurality of first solder bumps are essentially aligned with an upper surface of each of the plurality of contacts on a surface of the second substrate opposing the first substrate.	See solder bumps 15, which each have an upper surface aligned with surface 21 ("second substrate") of integrated circuit 1, which opposes integrated circuit 3 ("first substrate") and which are also aligned with an upper surface of each of contacts 7 (see Fig. 4).

Accordingly, withdrawal of the indefiniteness rejections of claims 1-6, 10-18, 20, 25, 55, 56, 58, and 59 under 35 U.S.C. §112, second paragraph, as being indefinite is requested.

Anticipation Rejection under 35 U.S.C. §102(b) over Nishiguchi

Withdrawal of the rejection of claims 1, 3-6, 18, 20, 25, 55, and 56 under 35 U.S.C. §102(b) as being anticipated by Nishiguchi (US 5,214,308) is requested.

Applicant notes that anticipation requires the disclosure, in a prior art reference, of each and every limitation as set forth in the claims.[6] There must be no difference between the claimed invention and reference disclosure for an anticipation rejection under 35 U.S.C. §102.[7] To properly anticipate a claim, the reference must teach every element of the claim.[8] "A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference".[9] "The identical invention must be shown in as complete detail as is contained in the ...claim."[10] In determining anticipation, no claim limitation may be ignored.[11] The applied art fails to meet the above-noted requirements, certainly at least for independent claims 1 and 55, as discussed below.

Nishiguchi et al., in contrast to Applicants' invention, is directed to a substrate for packaging a semiconductor device having a relatively large bump, which is received by a recess having an electrode terminal therein. The particular point of novelty of Nishiguchi et al. appears to be the use of a recessed electrode terminal as shown in Figs. 2-3, rather than merely a flat electrode terminal. The recessed electrode terminal is used for "coarse" positioning by physically moving the device, e.g., with a component placement machine, and then more precise positioning is accomplished by "merely lightly pushing the semiconductor device to the packaging substrate after coarse positioning to assure that the tops of the higher bump electrodes do not swell out of the recesses formed in the higher electrode terminals, the bump electrodes on

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[6] *Titanium Metals Corp. v. Banner*, 227 USPQ 773 (Fed. Cir. 1985).
[7] *Scripps Clinic and Research Foundation v. Genentech, Inc.*, 18 USPQ2d 1001 (Fed. Cir. 1991).
[8] *See* MPEP § 2131.
[9] *Verdegaal Bros. v. Union Oil Co. of Calif.*, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987).
[10] *Richardson v. Suzuki Motor Co.*, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989).
[11] *Pac-Tex, Inc. v. Amerace Corp.*, 14 USPQ2d 187 (Fed. Cir. 1990).

the semiconductor device can be highly precisely positioned to the electrode terminals on the packaging substrate."

By using the approach of Nishiguchi et al., the precision requirement for a positioning machine used to place the components in position for packaging was relaxed from ±10μm to ±50μm. With reference to Fig. 2 of Nishiguchi et al., a representative size of bump 2 formed on the semiconductor device 1 is indicated as being 80μm in diameter, while electrode terminal 5 on substrate 3 has a diameter of 100μm.

Thus, it appears clear that, even if Nishiguchi et al. discloses a C4 interconnection structure which anticipates applicants' invention, not a clear proposition given the level of integration and density present in the present application, Nishiguchi et al., at best, represents the conventionally achievable C4 approaches which rely upon external, mechanical force to push the contacts into alignment. Such conventional approaches are submitted as being unable to provide an interconnection density as in the present application, as described in Applicants' background section of the Specification, and as discussed above.

With respect to independent claim 1, Nishiguchi does not disclose a semiconductor structure for C4 interconnection of semiconductor devices, which includes, among other features, "a plurality of C4 contacts between the first substrate and the second substrate;...wherein the plurality of C4 contacts are further aligned between the first and second substrates by a surface tension provided by a solder material which is in contact with each of the plurality of C4 contacts."

Applicants submit that Nishiguchi does not rely solely upon a solder surface tension to align contacts 5b with solder bumps 2b. Nishiguchi confirms this fact at least at col. 1, line 63 through col. 2, line 1; col. 3, lines 19-29; and col. 5, lines 3-15, where physical "pushing" or other external movement are used for precise positioning, after coarse positioning by the relatively large recessed bumps.

Applicants further submit that the level of integration achievable by the external force application method of Nishiguchi represents the conventional approaches, which are necessarily

orders of magnitude less than that achievable by the claimed invention, even if any inherent tendency of solder surface tension to align contacts is considered.

As for independent claim 55, the applied art does not disclose a semiconductor structure for C4 interconnection of semiconductor devices, which includes, among other features, "a plurality of C4 contacts between the first substrate and the second substrate...wherein the plurality of C4 contacts are further moved into an aligned position between the first and second substrates by a solder material positioned in tensioned contact with each of the plurality of C4 contacts."

Similar arguments apply to claim 55, as were presented with claim 1, i.e., the manual application of force to precisely align the contacts in Nishiguchi would appear to simply represent the conventional C4 interconnection approaches discussed in the Specification, which the claimed invention is designed to overcome.

Accordingly, since the applied art does not disclose all the claim limitations discussed above, withdrawal of the rejection and allowance of amended claims 1 and 55 are requested.

As for dependent claims 2-6, 10-18, 20, and 25, these claims ultimately depend from independent claim 1, and are submitted as being allowable at least on that basis, as well as in their own right. Dependent claims 56 and 58-59, depending from independent claim 55, are likewise submitted as being allowable at least on the basis of the allowability of independent claim 55, as well as on their own merits.

Further, Applicants also respectfully request rejoinder and allowance of previously non-elected, dependent species claims 7-9, 19, and 21-24. The scope of independent claim 1 is submitted as being generic and still reading on the species represented by the dependent claims identified above.

Unpatentability Rejection under 35 U.S.C. §103(a) over Nishiguchi

Withdrawal of the rejection of claims 10-15 and 59 under 35 U.S.C. §103(a) as being unpatentable over Nishiguchi is requested.

At the outset, Applicant notes that, to establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference must teach or suggest all the claim limitations.[12] Further, the teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, not in applicant's disclosure.[13]

An essential evidentiary component of an obviousness rejection is a teaching or suggestion or motivation to combine (or modify) the prior art references.[14] Combining or modifying prior art references without evidence of a suggestion, teaching or motivation simply takes the inventors' disclosure as a blueprint for piecing together the prior art to defeat patentability – the essence of hindsight.[15]

"There are three possible sources for a motivation to combine references: the nature of the problem to be solved, the teachings of the prior art, and the knowledge of persons of ordinary skill in the art."[16] Further with regard to the level of skill of practitioners in the art, there is nothing in the statutes or the case law which makes "that which is within the capabilities of one skilled in the art" synonymous with obviousness.[17] The level of skill in the art cannot be relied upon to provide the suggestion to combine references.[18]

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[12] *See* MPEP §2143.
[13] *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991) and *See* MPEP §2143.
[14] *C.R. Bard, Inc. v. M3 Systems, Inc.*, 48 USPQ2d 1225 (Fed. Cir. 1998)
[15] *Interconnect Planning Corp. v. Feil*, 227 USPQ 543 (Fed. Cir. 1985)
[16] *See* MPEP §2143.01, citing *In re Rouffet*, 149 F.3d, 1350, 1357, 47 USPQ2d 1453, 1457-8 (Fed. Cir. 1998).
[17] *Ex parte Gerlach and Woerner*, 212 USPQ 471 (PTO Bd. App. 1980).
[18] *See* MPEP §2143.01, citing *Al-Site Corp. v. VSI Int'l Inc.*, 50 USPQ2d 1161 (Fed. Cir. 1999).

Further, [in a single reference obviousness rejection,] "[t]he test for an implicit showing is what the combined teachings, knowledge of one of ordinary skill in the art, and the nature of the problem to be solved as a whole would have suggested to those of ordinary skill in the art."[19]

The Examiner asserts that "it would have been an obvious matter of design choice bounded by well known manufacturing constraints and ascertainable by routine experimentation and optimization to choose these particular dimensions because applicant has not disclosed that the dimensions are for a particular unobvious purpose, produce an unexpected result, or are otherwise critical, and it appears *prima facie* that the process would possess utility using another dimension." Applicants respectfully traverse this assertion of "obvious design choice".

In similar circumstances relating to claims to an apparatus, "[t]he BPAI held that appellant had simply made an obvious design choice. However, the different structures of appellant and of the reference achieve different purposes."[20] Further, "[t]o require an applicant to include in his specification evidence and arguments regarding whether particular subject matter was a matter of 'design choice' would be tantamount to requiring the applicant to divine, before an application is filed, rejections the PTO will proffer. ***A finding of 'obvious design choice' is precluded where claimed structure and the function it performs are different from those of the prior art.***"[21] (emphasis added).

Applicants disagree with the Examiner's assertion of "obvious design choice", as the specification discusses the necessary structure, dimensional relationships, and alignment methodology required to achieve the fine alignment necessary for improved C4 contact interconnection, particularly where much higher contact densities, compared to the conventional approach, of about 100,000 contacts/cm^2 are necessary. Such contact densities are desirable in (C4) technology, and achievable by the recited invention, as discussed above. The necessary structure and alignment methodology to meet the stated dimensional objectives of the present application are submitted as not being taught or suggested by any of the cited or applied art.

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[19] *In re Kotzab*, 217 F.3d 1365, 1370, 55 USPQ2d 1313, 1317 (Fed. Cir. 2000). *See also In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988); *In re Jones*, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992); and *MPEP* §2144.01

[20] *In re Gal*, 25 USPQ 2d 1076, 1078 (Fed. Cir. 1992).

[21] *In re Chu*, 36 USPQ 2d 1089, 1095 (Fed. Cir. 1995).

The dimensional limitations disregarded by the Examiner are discussed, with the requisite specificity in the specification, at least at page 11, lines 11 through page 12, line 3. Thus, Applicants submit that the recited dimensional limitations are not a matter of obvious design choice, because the structure and dimensional aspects of the recited invention have been disclosed in terms of a particular, non-obvious purpose, with the criticality of the dimensions related to the function, structure, and design objectives of the claimed invention, i.e., a semiconductor device for C4 interconnection of semiconductor devices.

Applicants submit that the dimensional relationships, high levels of contact integration, and the resulting structure disclosed in the Specification and recited in these claims are not contemplated by Nishiguchi and, further, the function resulting from precisely aligning the contacts with the dimensional relationships claimed are not achievable by the manual alignment method of Nishiguchi used for final alignment, wherein an external force is used to align the contacts after the larger bumps are roughly positioned within their respective recesses.

In view of the above, reconsideration and allowance of claims 10-15 and 59 are requested.

Unpatentability Rejection under 35 U.S.C. §103(a) over Nishiguchi and Akamatsu

Withdrawal of the rejection of claims 2 and 16 under 35 U.S.C. §103(a) as being unpatentable over Nishiguchi in view of Akamatsu et al. (US 5,611,481) is requested.

Applicants submit that a person having skill in the art would not be motivated to combine the teachings of Nishiguchi et al. with Akamatsu in the manner suggested by the Examiner, as these two references are directed to the solution of different technical problems.

For example, Akamatsu et al. is concerned with forming a soldering metal connection between a semiconductor chip and a circuit board which is free from the wetability problem related to the repellency of an aluminum inter connection layer against the melt of soldering metal. Akamatsu et al. is also concerned with forming a soldering metal connection that is free from disconnection failures caused by thermal stress.

Applicants submit that it is only with the use of impermissible hindsight that the Examiner has combined these references. In particular, the Examiner's statement on page 12 of the Official

Action that "it would have been obvious to combine the product of Akamatsu with the product of Nishiguchi because it would provide contacts and first solder bumps" is submitted as providing evidence of the use of impermissible hindsight to cobble together this unpatentability rejection, as the Examiner uses the recitations of claim elements themselves as the motivation to combine the references.

Applicants respectfully submit that this approach is improper, and that the rejection is likewise improper, as the Examiner has failed to meet his burden in establishing a *prima facie* case of obviousness, as required.

Even assuming that the references are properly combinable as suggested by the Examiner, a proposition with which Applicants strongly disagree, Akamatsu still does not make up for the previously identified deficiencies of Nishiguchi, as discussed with respect to independent claim 1, above.

Accordingly, reconsideration and allowance of claims 2 and 16 are requested.

Anticipation Rejection under 35 U.S.C. §102(b) over Nishiguchi

Withdrawal of the rejection of claims 1 and 17 under 35 U.S.C. §102(b) as being anticipated by Nishiguchi (US 5,214,308) is requested.

Apparently due to oversight, a redundant anticipation rejection of claim 1 over Nishiguchi et al. is provided, and claim 17 was not included in the anticipation rejection set forth on page 7 of the Final Official Action over the same reference.

Notwithstanding this confusion, Applicants submit that the applied art does not teach all the claim recitions, as required.

With respect to independent claim 1, Nishiguchi does not disclose a semiconductor structure for C4 interconnection of semiconductor devices, which includes, among other features, "a plurality of C4 contacts between the first substrate and the second substrate;...wherein the plurality of C4 contacts are further aligned between the first and second substrates by a surface tension provided by a solder material which is in contact with each of the plurality of C4

contacts." As dependent claim 17 depends from independent claim 1 and, consequently incorporates its allowable features, claim 17 is submitted as being allowable at least on that basis, as well as in its own right.

Applicants submit that the above comments and arguments are responsive to every point of objection or rejection in the Final Official Action.

Applicants would also like to point out the allowable features of dependent claim 58, which was not rejected over any applied art, and whose recitations have been clarified, *supra*.

Dependent claim 58 recites "[a] semiconductor structure [of claim 55] which further compris[es] a ledge on the first substrate, wherein all of the plurality of contacts are arranged on the ledge such that a lower surface of each of the plurality of contacts is coplanar with the ledge, and none of the plurality of first solder bumps are coplanar with the ledge, and wherein an upper surface of each of the plurality of first solder bumps are essentially aligned with an upper surface of each of the plurality of contacts on a surface of the second substrate opposing the first substrate."

The applied art clearly does not teach or suggest, alone or in combination, the above-recited features. Therefore, the Examiner is encouraged to further reconsider the novel and non-obvious features recited in dependent claim 58.

In view of the above, each of the presently pending claims in this application is believed to be in immediate condition for allowance. Accordingly, the Examiner is respectfully requested to withdraw the outstanding rejection of the claims and to pass this application to issue.

Applicant believes no fee is due with this response. However, if a fee is due, please charge CBLH Deposit Account No. 22-0185, under Order No. 21806-059-US from which the undersigned is authorized to draw.

In the event that the Examiner believes an interview would be helpful in resolving any outstanding issues in this case, the undersigned attorney is available at the telephone number indicated below.

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The Examiner is respectfully requested to enter this Response After Final, in that it raises no new issues, but merely focuses the issues for appeal.

The Director is hereby authorized to charge any fees, or credit any overpayment, associated with this communication, including any extension fees, to CBLH Deposit Account No. 22-0185.

Respectfully submitted,

By Larry J. Hume

Larry J. Hume
Registration No.: 44,163
CONNOLLY BOVE LODGE & HUTZ, LLP
1990 M Street, N.W., Suite 800
Washington, DC 20036-3425
(202) 331-7111
(202) 293-6229 (Fax)
Attorneys for Applicant